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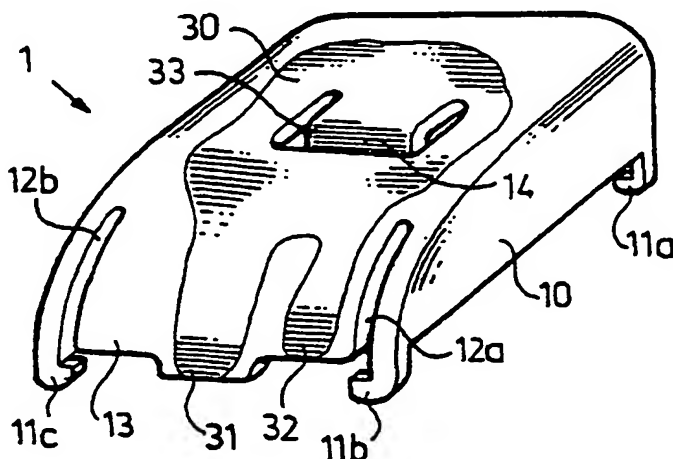
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ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.

(54) Title: UNITARY ANTENNA DEVICE



(57) Abstract: An antenna device for a portable radio communication device, comprises a unitary support structure (10) with an antenna element (30) provided thereon. The antenna element has a feeding portion (33) connectable to a feed device and a grounding portion (31) connectable to a grounding device. The support structure is adapted to be mounted to a PCB (20) and is provided with one or more resilient wings (13, 14) with at least a feeding portion or a grounding portion. The wings are adapted to press on the underlying PCB when the support structure is mounted thereto. The antenna device is easy and inexpensive to manufacture and mount and good radio frequency coupling is achieved between the antenna element and the PCB.

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UNITARY ANTENNA DEVICEFIELD OF INVENTION

The present invention relates generally to antenna devices and more particularly to an antenna device in one part designed for use in a portable communication device, such as a mobile phone.

BACKGROUND

It is previously known to provide an internal antenna device as a module adapted to be fitted into the interior of a portable communication device. However, the module is often difficult and expensive to assemble and the contacting to the electronic circuitry of the device to which the module is mounted is space consuming and unreliable, relying on contact pins with limited contact area, for example. Alternatively, soldering is used, which adds another step to the assembly process, increasing total costs.

The patent publication US 4,876,709 (Rogers et al.) discloses an antenna internally contained within a housing of a cordless telephone and adapted for snap-in engagement with suitably configured bosses within the housing. However, the connection of the antenna to the internal electronic circuitry is not described.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an antenna device, which is easy and inexpensive to manufacture, and which is easy to mount in a portable communication device.

Another object is to provide an antenna device wherein the connection to electronic circuitry is facilitated.

The invention is based on the realisation that an antenna pattern can be provided on a single part functioning as a frame, wherein the connection details are  
5 integrated in the frame.

According to the present invention there is provided an antenna device as defined in appended claim 1 and a portable communication device as defined in appended  
10 claim 16.

Further preferred embodiments are defined in the dependent claims.

The invention provides an antenna device, which is easy and inexpensive to manufacture and which is easy  
15 to mount to e.g. a printed circuit board having electronic circuitry to be connected to the antenna device.

#### BRIEF DESCRIPTION OF DRAWINGS

The invention is now described, by way of example,  
20 with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of an antenna device according to the invention;

FIG. 2 is an end view of the antenna device shown in FIG. 1;

25 FIG. 3 is a sectional view through the antenna device of FIGS. 1 and 2 along the lines III-III; and

FIG. 4 is a perspective view of an alternative embodiment of an antenna device according to the invention.

#### DETAILED DESCRIPTION OF THE INVENTION

In the following, a detailed description of preferred  
5 embodiments of an antenna device according to the invention will be given, first with reference to FIG. 1. An antenna device or module, generally designated 1, comprises an essentially box like frame or support  
10 structure 10 made of some suitable non-conductive material, such as moulded plastics. The frame is provided with a contour so as to fit within the housing of a mobile phone or other portable communication device (not shown). Thus, by adapting the shape of the frame to the shape of the communication device in  
15 which it is to be mounted, space is used in an optimum way, which is of vital importance with today's ever-increasing demand for smaller communication devices.

The frame 10 is provided with four resilient legs, each of which is provided with a hook, three of which  
20 11a-c are shown in FIG. 1. The hooks are adapted for gripping around the edges of a printed circuit board (PCB) 20, see FIG. 2. When the frame 10 is mounted to the PCB 20 during assembly, the frame is simply  
25 pressed to the PCB and the hooks provide a snap-in function, fixing the frame in the position shown in FIGS. 2 and 3.

Two essentially parallel slits 12a, 12b are provided at one end of the frame 10, defining there between a wing or tongue 13. A similar wing 14 is provided at  
30 the centre portion of the frame 10, see FIGS. 1 and 3.

The function of these wings 13, 14 will be described below.

The upper side of the frame 10 is provided with an electrically conductive radiating antenna element, generally designated 30. The antenna element can have any suitable shape giving required characteristics to an internal antenna. However, the general shape is often that the antenna element is parallel to and spaced apart from the PCB 20, which in many cases functions as a ground plane for the antenna.

The antenna element 30 can be provided as a flex film, which is fixed to the frame in some suitable way, e.g. by means of an adhesive. Alternatively, the antenna element is provided by means of a so-called moulded interconnected device (MID) process, wherein the antenna pattern is provided as a metallisation directly on a suitable plastic material.

The function of the wings 13, 14 will now be described. As is seen in FIG. 3, the respective end portion of the wings rests on the PCB 20 exerting a force thereon when the frame is snapped on to the PCB. This force is due to that at least part of the wings extends beneath the rest of the frame 10 by a distance  $d$ , see FIG. 2, and that the entire wings thus function as spring elements pressing the ends thereof against the PCB 20. The exerted force depends on the distance  $d$  and the length of the slits 12a, 12b for the first wing 13 and corresponding parameters for the second wing 14. In the preferred embodiment, the wings extend 0.2-0.3 millimetres below the frame, i.e., the

distance  $d$  is 0.2-0.3 millimetres. The position of the first wing 13 in mounted position appears clearly from FIG. 2.

Part of the radiating element 30 extends down the wings 13, 14 and around the edges thereof so that a contact portion on each wing rests against the PCB 20. Such a portion 31 of the antenna element 30 is shown in FIGS. 1 and 2. The PCB is provided with corresponding metallisation areas functioning as contact portions on the PCB.

The wing arrangement provides for a simple yet reliable connector providing electrical contact between the antenna element 30 and the PCB 20. From a radio frequency point of view, this arrangement is very advantageous in that the contact area can be varied, extending from a small part of the wing edge to a major part thereof. Apart from providing a reliable connection, the configuration of the contact area can be varied in order to achieve RF matching of the antenna element.

An example of capacitive coupling between the antenna element 20 and the PCB is also shown in FIGS. 1 and 2. A portion 32 of the antenna pattern 30 extends to the edge of the wing 13 in an area where the edge is not in direct contact with the PCB 20, see FIG. 2, but is spaced apart therefrom by the distance  $d$ . Thus, if the PCB 20 is provided with a conductive layer directly below the portion 22, a well-defined capacitive coupling is obtained between the antenna element 30 and the PCB 20.

In the example illustrated in FIGS. 1-3, two wings 13, 14 are provided, wherein the antenna element portion 31 provided on the first wing 13 functions as a grounding portion and a corresponding portion 33 provided on the second wing 14 functions as a feeding portion.

An alternatively shaped antenna device 40 is shown in FIG. 4. However, this embodiment has the same general properties as the one described with reference to FIGS. 1-3.

With the antenna device according to the invention, an antenna element module is provided wherein no extra connectors are needed, i.e., all essential components are provided in one carrier, such as the radiating element itself, contacting thereto, attachment devices for attaching the carrier to a PCB etc.

With the inventive device, improved radio frequency performance is achieved due to improved contact properties. Another advantage is that the area of the frame can be fully used as opposed to prior art devices, wherein contact pins have been used.

Preferred embodiments of an antenna device according to the invention have been described. However, the person skilled in the art realises that these can be varied within the scope of the appended claims without departing from the inventive idea. Embodiments with two wings have been described. However, more than two wings can be provided if more than one antenna element is provided on the frame, for example. In other applications one single wing is sufficient. Also, the

wings can have any suitable shape and position. For example, instead of providing one of the wings in the centre portion of the frame, it can be provided at the opposite end of the frame compared to the first wing.

- 5 Also, each wing can be provided with more than one contact area.

- Specific antenna patterns have been shown. However, any antenna pattern is possible, as long as it is adapted for a built in antenna, such as a PIFA, patch  
10 or meander antenna etc. It is also possible to provide an antenna pattern on the underside of the frame 20. It is also possible to provide discrete components by means of surface mounting, for example, which can be used for antenna matching etc.

- 15 Frames with four legs have been disclosed. The person skilled in the art realises that the frame can be provided with any suitable number of legs or other attachment devices.



## CLAIMS

1. An antenna device for a portable radio communi-  
5 cation device, comprising

- a unitary support structure (10),
- an antenna element (30) provided on said support structure, said antenna element having at least one of a feeding portion (33) connectable to a feed  
10 device and a grounding portion (31) connectable to a ground device,

characterised by

- said support structure (10) being adapted to be mounted to a printed circuit board (20), and
- 15 - said support structure (10) being provided with at least one resilient wing (13, 14) provided with at least a feeding portion (33) or a grounding portion (31), wherein said at least one wing is adapted to press on said printed circuit board (20) when said  
20 support structure is mounted thereto.

2. The antenna device according to claim 1, wherein said support structure (10) is essentially box like.

3. The antenna device according to claim 1 or 2,  
25 wherein said support structure (10) is shaped so as to fit the housing of said portable radio communication device.

4. The antenna device according to any of claims 1-3, wherein said support structure (10) comprises attachment devices, preferably resilient legs having a respective hook (11a-c), for attachment to said printed circuit board (20).

5. The antenna device according to any of claims 1-4, wherein said support structure is provided with at least two slits (12a, 12b), whereby a wing (13) is provided there between.

10 6. The antenna device according to any of claims 1-5, wherein said antenna element (30) is spaced apart from said printed circuit board (20) when said support structure (10) is mounted to said printed circuit board.

15 7. The antenna device according to claim 6, wherein said antenna element (30) is essentially parallel to said printed circuit board (20) when said support structure (10) is mounted to said printed circuit board.

20 8. The antenna device according to any of claims 1-7, wherein said antenna element (30) is provided as a conductive element on a flex film.

9. The antenna device according to any of claims 1-8, wherein an end portion of said wing (13) is provided with a part protruding from other parts of said end portion, wherein said protruding part is at least partly covered by a portion (31) of said antenna element (30), thereby providing galvanic coupling with a conductive area provided on said printed circuit

board (20) when said support structure (10) is mounted to said printed circuit board.

10. The antenna device according to any of claims 1-9, wherein an end portion of said wing (13) is provided with a part protruding from other parts of said end portion and said other parts are at least partly covered by a portion (32) of said antenna element (30), thereby providing capacitive coupling with a conductive area provided on said printed circuit board (20) when said support structure (10) is mounted to said printed circuit board.

11. The antenna device according to claim 9 or 10, wherein said protruding part protrudes by a distance (d) of 0.2 - 0.3 millimetres from said other parts.

12. The antenna device according to any of claims 1-11, wherein said feeding portion (33) and/or said grounding portion (31) are configured so as to achieve radio frequency matching of said antenna element (30).

13. The antenna device according to any of claims 1-12, wherein said support structure (10) is hollow.

14. The antenna device according to claim 13, wherein said support structure (10) is provided with two sides and said antenna element (30) is provided on both sides of said support structure (10).

15. The antenna device according to any of claims 1-14, wherein said antenna element (30) forms part of a PIFA, patch or meander antenna.

16. A portable communication device comprising an antenna device according to any of the preceding claims.

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Fig.1

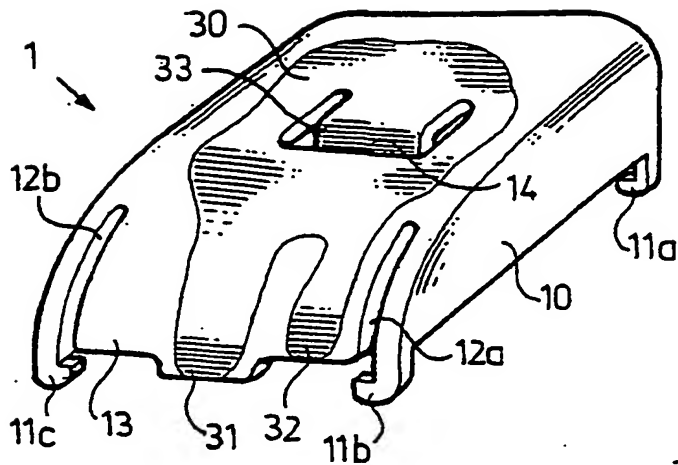


Fig.2

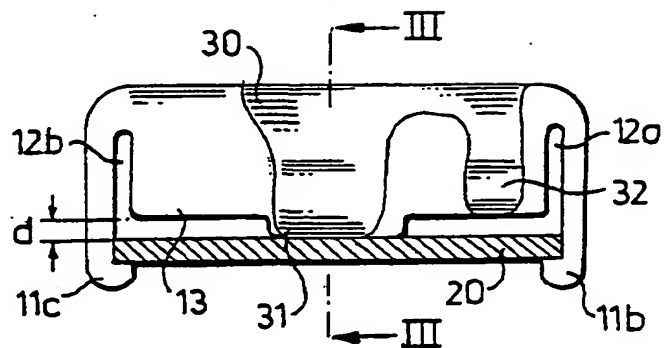


Fig.3

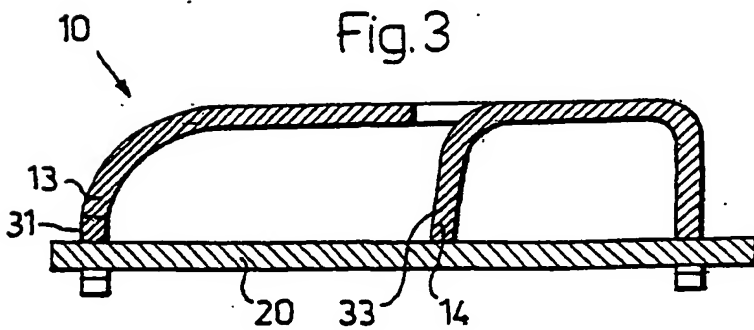
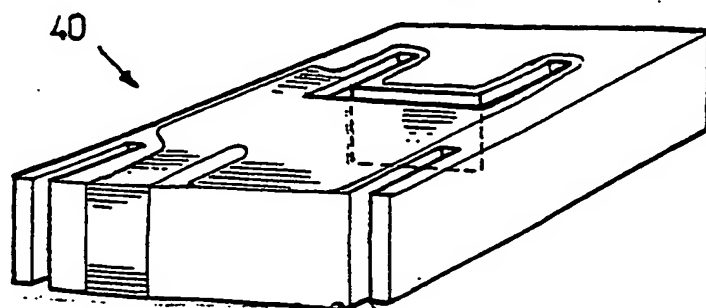


Fig 4



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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 01/01414

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
IPC7: H01Q 1/24, H01Q 1/38 According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols)		
IPC7: H01Q		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
SE,DK,FI,NO classes as above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
EPO-INTERNAL, PAJ		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Patent Abstracts of Japan, abstract of JP 11-168316 A (FURUKAWA ELECTRIC CO LTD: THE), 22 June 1999 (22.06.99)	1-16
&	JP 11-168316 (FURUKAWA ELECTRIC CO LTD: THE) 22.06.1999, figure 3	
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A	Patent Abstracts of Japan, abstract of JP 11-355034 A (NEC CORP), 24 December 1999 (24.12.99)	1-16
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<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
18 Sept 2001		27-09-2001
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International application No.

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

03/09/01

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